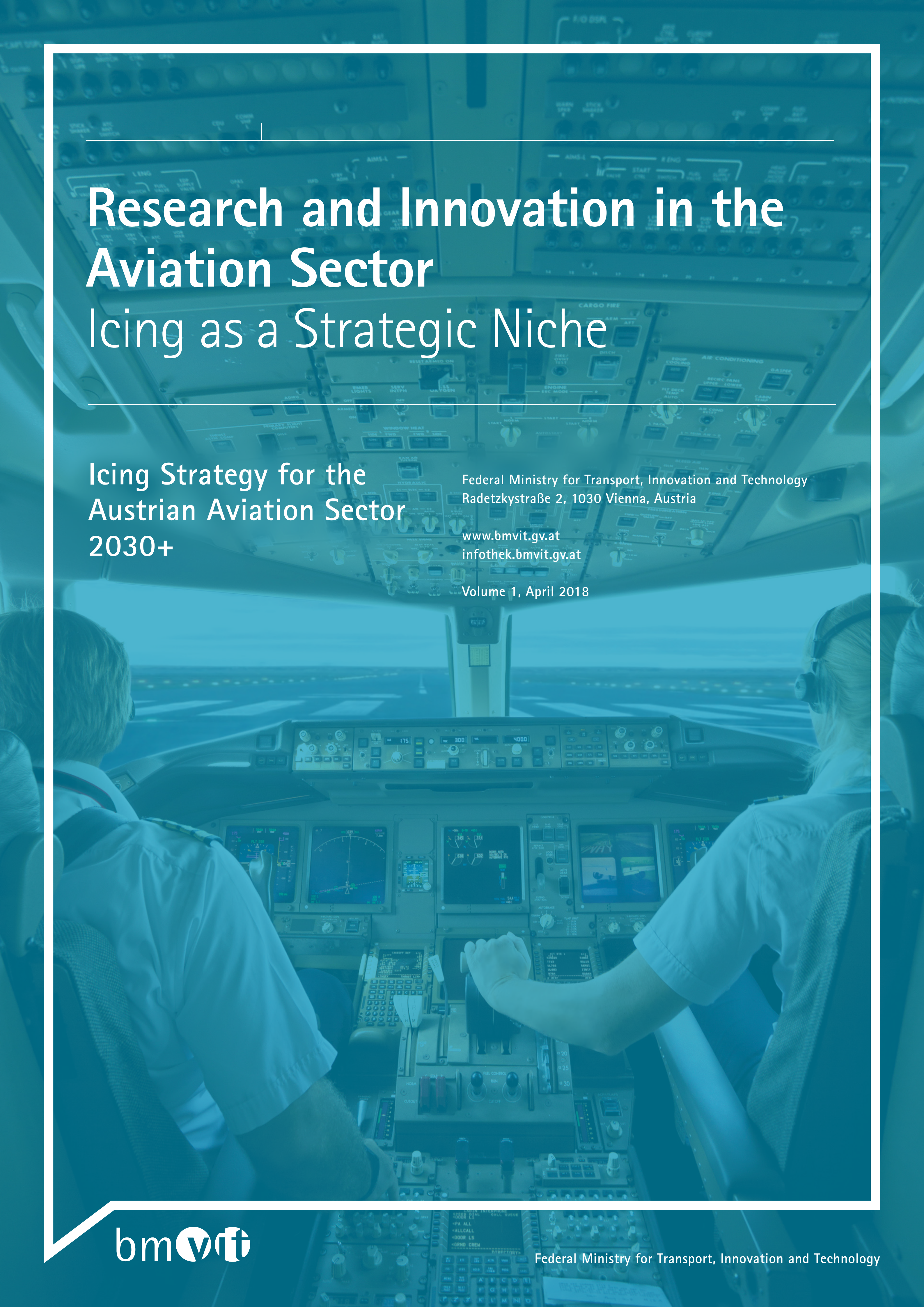

Research and Innovation in the Aviation Sector

Icing as a Strategic Niche

Icing Strategy for the Austrian Aviation Sector 2030+

Federal Ministry for Transport, Innovation and Technology
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Contents

Abbreviations & Definitions

Anti-icing	Technology used for preventing ice accretion
Appendix C, O und P	Appendix C, O and P on icing conditions of EASA CS-25
De-icing	Technology used for removing ice accretion
FIKI	Flight into known icing conditions
Ice protection systems (IPS)	De-icing and anti-icing systems
Ice sensing	Technology used for detecting atmospheric icing conditions
Ice tanker	Aircraft equipped with a water tank and a spray bar generating icing conditions in flight using ambient temperature
Icing wind tunnel	Experimental test facility simulating icing conditions in a wind tunnel
In-flight icing	Experimental or natural icing conditions on flying aircraft
Key (icing) facility	Strategic test facility with associated technologies, services and technical expertise (e.g. experimental and numerical simulations); an overview of European key facilities can be found at https://www.airtn.eu/catalogues/research-facilities
Mixed phase	Conditions containing ice crystals and supercooled liquid water droplets
Ice crystals	Solid state ice crystals
R&D	Research & Development
SLD	Supercooled large water droplets
Thermal control	In this context: thermal control of aircraft or vehicles through controlled supply of heat
TKS system	Technology that involves exuding de-icing fluid at the wing leading edges to provide a protective film
TRL	Technology readiness level: method for categorising technology maturity on a scale from 1 (basic research) to 9 (ready for the market)
UAV	Unmanned aerial vehicle

1. Ice Protection Technology in Austria: innovative, diverse, dynamic

Ice protection of aircraft both in flight and on ground contributes substantially to increased safety and improved performance in the aviation sector. Austrian research in the fields of icing and ice protection in aviation has made great progress over the past few years. The present strategy seeks to pool these fields of expertise in order to achieve higher visibility at European and international level and improve the strategic position of Austrian research, innovation and technology in the face of global competition. Icing R&D includes applications for UAVs, helicopters, airplanes and other propulsion systems.

1.1. Competitive edge through research and innovation

Austria began to develop expertise in the field of icing and ice protection in the early 2000s, albeit only in a fragmentary fashion. A consistent sequence of cooperative research and development projects have given Austria a competitive edge in icing research for aviation and have substantially expanded national expertise in this sector. This expertise has consequently opened up the opportunity for Austrian companies and research institutions to participate in European programmes.

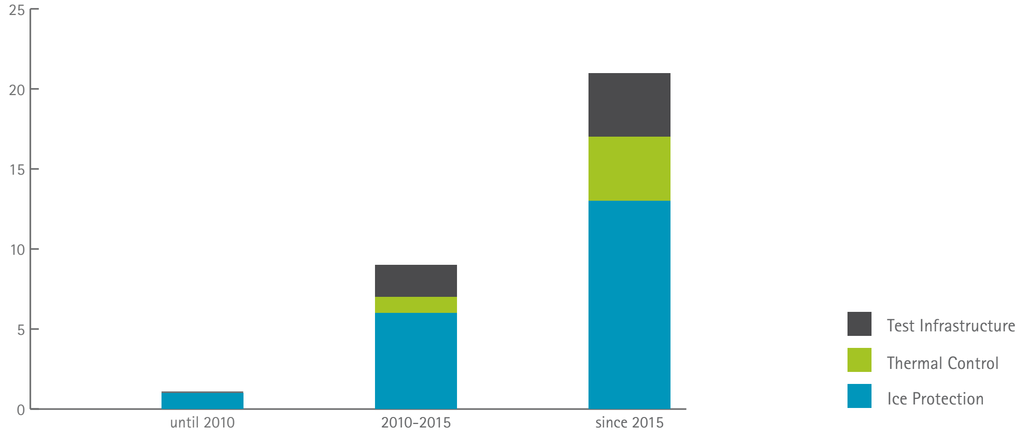

Figure 1: R&D projects with Austrian participation in the fields of Ice Protection, Thermal Control and Test Infrastructure

Austria has participated in some thirty national and European research and development projects in the field of ice protection and thermal control since 2010. On top of that, the Icing Wind Tunnel (IWT) in Vienna, which was opened in 2013, additionally provides a key research infrastructure for aviation applications. The developments over the past few years have shown that icing research is increasing in importance for the aviation sector and has become an important strategic niche for Austrian companies and research institutions.

1.2. Fields of expertise in a strategic niche

Austrian companies and research institutions have carried out extensive icing research together with international partners in largely public funded projects over the past few years. This has created a strategic niche and helped acquire key expertise in the fields of Ice Protection, Thermal Control and Test Infrastructure.

Ice Protection

Austrian research and development projects in the field of Ice Protection include both anti-icing and de-icing solutions with a focus on methods for monitoring, detecting and measuring ice formation and composition. The aircraft de-icing methods developed range from hydrophobic coatings to electrothermal de-icing systems. The design of ice protection systems often involves the use of numerical simulation models.

The following is an overview of projects in the field of Ice Protection:

MixVal
Modelling of flow processes for precise detection of ice formation and accumulation
Project participants: Airbus Deutschland GmbH, FH JOANNEUM GmbH, Prisma Engineering GmbH, TU Graz
Project duration: 2008-2010
Funding programme: Take Off

Anti-Ice
Development of anti-icing/de-icing systems to improve aircraft safety and performance
Project participants: Aerospace & Advanced Composites GmbH, Austrian Research Centers GmbH, FH JOANNEUM GmbH, LKR Leichtmetallkompetenzzentrum Ranshofen GmbH, PROFACTOR GmbH, TU Graz
Project duration: 2009-2011
Funding programme: Take Off

HEAT
Testing of special heating paints for a light, simple and flexible aircraft de-icing system
Project participants: Aerospace & Advanced Composites GmbH, AIT Austrian Institute of Technology GmbH, FH JOANNEUM GmbH, LKR Leichtmetallkompetenzzentrum Ranshofen GmbH, qpunkt GmbH, Villinger GmbH
Project duration: 2010-2012
Funding programme: Take Off

IceGrid
Investigation of ice formation on protection grids in aircraft air-conditioning systems
Project participants: Aerospace & Advanced Composites GmbH, FH JOANNEUM GmbH, ICON, TU Graz, Villinger GmbH
Project duration: 2011-2013
Funding programme: Take Off

AAP3
Investigation of advanced de-icing systems for aircraft propellers
Project participants: AIT Austrian Institute of Technology GmbH, Austro Engine GmbH, LKR Leichtmetallkompetenzzentrum Ranshofen GmbH, MT-Propeller Entwicklung GmbH, RTA Rail Tec Arsenal Fahrzeugversuchsanlage GmbH, Villinger GmbH
Project duration: 2011-2013
Funding programme: General Programme, EraSME Proposal

Turbine blade de-icing
Investigation of effective de-icing methods for wind turbine blades - know-how transfer to aviation
Project participants: Aerospace & Advanced Composites GmbH, AIT Austrian Institute of Technology GmbH, LKR Leichtmetallkompetenzzentrum Ranshofen GmbH, Österreichisches Forschungs- und Prüfzentrum Arsenal GmbH, STERNWIND Errichtungs- und Betriebs-GmbH, Villinger GmbH, WEB Windenergie AG
Project duration: 2011-2015
Funding programme: Energy Research Programme

eWing DE-ICER
Development of an energy-efficient electrothermal de-icing system for wing leading edges in aviation
Project participants: FH JOANNEUM GmbH, IESTA Institute for Advanced Energy Systems & Transport Applications, qpunkt GmbH, RTA Rail Tec Arsenal Fahrzeugversuchsanlage GmbH, Villinger GmbH
Projektlaufzeit: 2013-2014
Funding programme: Take Off

TWID
Development of a thermal system for ice detection and thickness measurement
Project participants: AVL qpunkt GmbH, FH JOANNEUM GmbH, IESTA Institute for Advanced Energy Systems & Transport Applications, Infineon Technologies Austria AG
Project duration: 2014-2016
Funding programme: Take Off

IceDrip
Combination of discontinuous electrothermal de-icing with (super)hydrophobic coatings
Project participants: Aerospace & Advanced Composites GmbH, FH JOANNEUM GmbH, Rail Tec Arsenal Fahrzeugversuchsanlage GmbH, JOANNEUM RESEARCH Forschungsgesellschaft mbH, Rembrandtin Lack GmbH Nfg. KG, Villinger GmbH
Project duration: 2014-2017
Funding programme: Take Off

eGround
Development and proof of concept of an electrothermal ground de-icing system
Project participants: CEST Kompetenzzentrum für elektrochemische Oberflächen GmbH, RTA Rail Tec Arsenal Fahrzeugversuchsanlage GmbH, Tiroler Flughafenbetriebsgesellschaft m.b.H., University of Innsbruck, Villinger GmbH
Project duration: 2014-2017
Funding programme: Take Off

AdBlue Anti-Icing
Development of a defrosting and anti-icing system for AdBlue tanks based on printed infrared heating elements for series production and integration in an automotive Tier-1 system - know-how transfer to aviation
Project participants: ATT advanced thermal technologies GmbH, Kautex Textron GmbH & Co KG
Project duration: 2015-2017
Funding programme: no public funding

ICELIFT
Feasibility study of a system for aircraft wing monitoring using a network of wireless sensors
Project participants: eologix sensor technology gmbh, FH JOANNEUM GmbH, University of Klagenfurt, Villinger GmbH
Project duration: 2015-2018
Funding programme: Take Off

Wing DeIcing
Development and reference setup of a wing de-icing system with four different infrared heating zones and three different sensor systems
Project participants: ATT advanced thermal technologies GmbH, Liebherr-Aerospace Toulouse SAS
Project duration: 2016-2017
Funding programme: no public funding

eco2jet
Improvement of the energy efficiency of rail vehicles in heating and cooling operation, including through integration of a de-icing concept for external heat exchanger fins and heating of the interior using infrared heating film - know-how transfer to aviation
Project participants: ATT advanced thermal technologies GmbH, IESTA Institute for Advanced Energy Systems & Transport Applications, Liebherr-Transportation Systems GmbH & Co KG, Obrist Engineering GmbH, ÖBB-Technische Services-GmbH, Rupert Fertinger GmbH, TU Graz, VIRTUAL VEHICLE Research Center
Project duration: 2016-2019
Funding programme: no public funding

NO-ICE-Rotor
Development and demonstration of an ultra-high reliability thermal de-icing system for high strain rotor blades and airframe sections of a civil tilt rotor
Project participants: AIT Austrian Institute of Technology GmbH, AVIATEST Ltd., CEST Kompetenzzentrum für elektrochemische Oberflächen GmbH, RTA Rail Tec Arsenal Fahrzeug-versuchsanlage GmbH, Villinger GmbH
Project duration: 2016-2019
Funding programme: H2020

Printed Ice-Sensor
Development of an ice sensor printed on film for measuring ice layer characteristics (thickness, structure, water film, etc.) on a capacitive basis
Project participants: ATT advanced thermal technologies GmbH
Project duration: 2018-2019
Funding programme: no public funding

HIS
Development of innovative technologies for a complete de-icing system for small and medium-sized helicopters
Project participants: CEST Kompetenzzentrum für elektrochemische Oberflächentechnologie GmbH, Helikopter Air Transport Gesellschaft m.b.H., Austrian Institute of Icing Sciences (AIIS), RTA Rail Tec Arsenal Fahrzeugversuchsanlage GmbH, Villinger GmbH
Project duration: 2018-2020
Funding programme: Take Off

LubRes
Development of innovative, ice-repellent paints based on liquids embedded in a lacquer matrix
Project participants: Aerospace & Advanced Composites GmbH, CEST Kompetenzzentrum für elektrochemische Oberflächentechnologie GmbH, Rembrandtin Lack GmbH Nfg. KG, RTA Rail Tec Arsenal Fahrzeugversuchsanlage GmbH
Project duration: 2018-2020
Funding programme: Take Off

InSPIRe
Design and development of a safe, reliable and compact electrothermal de-icing system integrated in the wing leading edge for future European regional aircraft, including technology demonstration in the icing wind tunnel
Project participants: AeroTex UK LLP, AIT Austrian Institute of Technology GmbH, CEST Kompetenzzentrum für elektrochemische Oberflächen GmbH, Peak Technology GmbH, Villinger GmbH
Project duration: 2018-2021
Funding programme: Clean Sky II

I³PS
Integration and testing of two innovative de-icing systems based on two-phase heat transport and electromagnetic induction
Project participants: Cranfield University, Euro Heat Pipes S.A., IKERLAN, S. Coop., RTA Rail Tec Arsenal Fahrzeugversuchsanlage GmbH, Sonaca S.A.
Project duration: 2018-2020
Funding programme: Clean Sky II

Thermal Control

Over the past decade, Austrian research players have also successfully built up thermal control expertise for aircraft and vehicle interiors. Projects range from the development of interior heating systems based on heating paints or heating films to stabilising temperature fluctuations in battery cells. The knowledge and technological solutions developed for rail and electric vehicles can in many instances be transferred to applications in the aviation sector.

The following is an overview of projects in the field of Thermal Control:

Eko-Lack
Testing of energy-efficient concepts and technologies for paint-based heating systems in electric vehicles
Project participants: academia nova GmbH, AIT Austrian Institute of Technology GmbH, LKR Leichtmetallkompetenzzentrum Ranshofen GmbH, qPunkt GmbH, Villinger GmbH
Project duration: 2012-2014
Funding programme: IV2Splus

Heli Comfort
Development of an adaptable power density coating for energy-efficient heating of cockpit and cabin
Project participants: AIT Austrian Institute of Technology GmbH, CEST Kompetenzzentrum für elektrochemische Oberflächen GmbH, H4Aerospace Ltd., LKR Leichtmetallkompetenzzentrum Ranshofen GmbH, RTA Rail Tec Arsenal Fahrzeugversuchsanlage GmbH, Villinger GmbH
Project duration: 2014-2016
Funding programme: Clean Sky

b-PCM
Stabilising temperature fluctuations in thermally sensitive battery cells via integration of latent heat storage media (PCM) and a battery heating system within the battery pack
Project participants: AIT Austrian Institute of Technology GmbH, LKR Leichtmetallkompetenzzentrum Ranshofen GmbH, qPunkt GmbH, Villinger GmbH
Project duration: 2015-2017
Funding programme: Energy Research Programme

eMPROVE
Increasing the energy efficiency of electric vehicles, including through the use of infrared heating films in the interior, gearbox and battery modules
Project participants: 4a manufacturing GmbH, advanced thermal technologies GmbH, AIT Austrian Institute of Technology GmbH, AVL List GmbH, IESTA Institute for Advanced Energy Systems & Transport Applications, LKR Leichtmetallkompetenzzentrum Ranshofen GmbH, MAGNA STEYR Battery Systems GmbH & Co OG, Montanuniversität Leoben, REDUX Recycling GmbH, Saubermacher Dienstleistungs AG, VIRTUAL VEHICLE Research Center, Zörkler Gears GmbH & Co KG
Project duration: 2015-2018
Funding programme: Austrian Electric Mobility Flagship Projects

Marine Anti-Icing
Development of an infrared heating system for supporting ice-free functioning of the hatch system in a marine application for near-polar regions
Project participants: ATT advanced thermal technologies GmbH, defence industry company
Project duration: 2016-2018
Funding programme: no public funding

Test Infrastructure

The availability of dedicated test infrastructure for icing research over the past few years has made an important contribution to building up relevant expertise in Austria. The existing test infrastructure and technologies for use in icing wind tunnels are being continuously improved and developed in order to provide an ideal environment for future national and international research and development activities in this field.

The following is an overview of projects in the field of Test Infrastructure:

Icing Rig
Start of the first icing tests with the prototype of the new de-icing test facility under supervision of EASA together with Agusta Westland, 2012
Opening of the icing rig as part of the first certification tests, 2014
Project participant: RTA Rail Tec Arsenal Fahrzeugversuchsanlage GmbH
Project duration: 2012-2014
Funding provider: Vienna Tax Authority through tax allowances for investments

I-Tests – Aviation Icing Tests
Complete calibration of the Icing Wind Tunnel for large helicopters (CS-29 Appendix C acc. to SAE ARP5905)
Project participant: RTA Rail Tec Arsenal Fahrzeugversuchsanlage GmbH
Project duration: 2014-2015
Funding programme: General Programme

I-Tests II – Aviation Icing Tests II
Expansion of the Icing Wind Tunnel portfolio for tests in freezing rain and freezing fog.
Project participant: RTA Rail Tec Arsenal Fahrzeugversuchsanlage GmbH
Project duration: 2015-2016
Funding programme: General Programme

Aircraft-icing 4.0
High-precision 3D documentation of ice structures and 3D printing of flexible ice films for use in flight tests and wind tunnel tests.
Project participant: Austrian Institute of Icing Sciences (AIIS)
Project duration: 2016-2017
Funding programme: no public funding, nominated for the Austrian Mobility Award

AquaSense
Development of a method for simultaneous detection of the physical state and concentration of water in flowing media for use in icing wind tunnels.
Project participants: AVL List GmbH, FH JOANNEUM GmbH, RTA Rail Tec Arsenal Fahrzeugversuchsanlage GmbH
Project duration: 2015-2018
Funding programme: Take Off

Small-Scale Icing Tests
Efficient test facility for testing systems under realistic icing conditions.
Project participant: FH JOANNEUM GmbH
Project duration: 2010-2018
Funding programme: no public funding

Figure 2: The IWT in Vienna allows icing tests to be carried out at speeds of up to 300 km/h across an icing cross section of 8.75 m^2; source: Rail Tec Arsenal

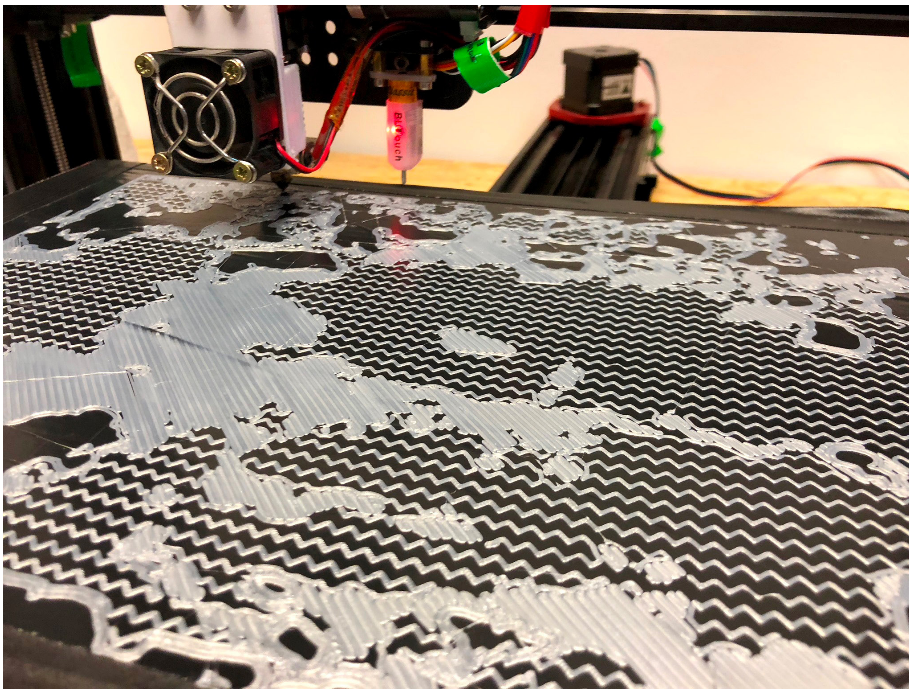

Figure 3: 3D printed ice film; source: AIIS

Note:
For more information on the projects see:
www.open4aviation.at, https://projekte.ffg.at and https://cordis.europa.eu

2. Expertise and technology gaps: an analysis of the European and international environment

European aircraft and component manufacturers, service providers and research institutions have extensive expertise in the field of aircraft ice protection. Ground and aircraft de-icing technologies increase flight safety in icing conditions and safeguard the operability of aircraft under the most adverse weather conditions. Different technologies are used on the ground or on the aircraft to remove or prevent ice build-up on aircraft structures. However, various gaps can also be identified, especially as regards the availability of key icing facilities in Europe.

2.1. Ground de-icing

Ground de-icing technologies primarily include de-icing trucks equipped with spray guns that apply de-icing fluid to aircraft. Expertise in the application of this technology lies with the airport service companies.

The de-icing fluids are applied prior to take-off and vary depending on weather conditions and type of aircraft. The necessary infrastructure for large airliners is available at major airports, while small airfields operating small aircraft or helicopters often lack appropriate equipment.

Moreover, traditional de-icing processes cost time and money. Airports regularly report flight delays and cancellations caused by heavy snowfalls in winter. Innovative ground de-icing technologies such as electrothermal de-icing systems provide time and cost efficient de-icing and thus represent a competitive advantage for airline companies and airport operators. More efficient systems would minimise the negative economic effects on these companies and ensure more sustainable operation. The disposal of operating fluids and aspects of environmental protection in particular should not be neglected in this context.

2.2. In-flight icing

Turbine aircraft often use anti-icing systems operated with engine bleed air for wing de-icing and electric heaters for sensor de-icing. Turboprop aircraft are usually equipped with pneumatic boots in order to adjust system energy demand to engine performance. TKS systems are conventionally used for small aircraft, while helicopters employ a range of different technologies to combat icing, which mainly occurs at the rotor and air intakes.

All these systems have one aspect in common: they must be taken into account as early as the design phase and require testing and/or simulation and final validation on the aircraft or in an icing wind tunnel.

Numerical and analytical tools which can simulate different aerodynamic shapes and operating parameters of aircraft are therefore gaining importance. These tools allow local conditions to be analysed for critical operating modes so that ice protection systems can be exactly tailored to requirements. Computer models that enable a sufficiently realistic simulation of ice accretion are also increasingly being used for verification in aircraft certification in addition to tests carried out in the icing wind tunnel.

It is essential that these simulation tools are validated in order to generate realistic to conservative analyses which can be extrapolated to extreme icing conditions. Validation involves instrumented flight tests in natural icing conditions and experimental tests carried out either in an icing wind tunnel or during flight tests in icing conditions created by ice tankers.

European aircraft and engine manufacturers have key expertise in de-icing technologies for both aircraft and engines.

2.3. Ice tankers

Ice tankers are clearly lacking in the European key infrastructure landscape. There is currently no "large" ice tanker available in Europe which could produce icing conditions on the rotor of a helicopter or a larger section of an airplane. These conditions can only be achieved by either resorting to ice tankers based in the USA or by icing local areas using small spray bars.

2.4. Engine icing

Europe also lacks flying test beds for icing tests on engines. This method is used where engines cannot be tested on the actual aircraft in natural icing conditions. A ground-based engine test bed that is able to create icing conditions according to CS-E, CS-25 Appendix C, Appendix O SLD and Appendix P Mixed Phase and Ice Crystal could be an alternative to fill this gap.

Another gap exists for test beds that are able to produce icing conditions for rotor tests. A test bed of this kind would also expand the European infrastructure for icing tests.

2.5. Air data probe ice protection

Only a few icing wind tunnels worldwide are able to simulate the requirements for the qualification of air data probes in ice crystal conditions. These requirements have recently been further expanded by the EASA Special Condition "Air Data Probes Qualification in Ice Forming Conditions" in order to adjust qualification to the meteorological conditions under which modern aircraft must operate at high altitudes.

2.6. Experimental and numerical simulation

The topic of numerical and experimental simulation is of great significance for the development of ice protection technologies. Experimental simulation allows ice accretion to be efficiently investigated under different operating conditions. It can also be used for verifying the proper functioning of de-icing technologies and for validating numerical simulation models.

Both types of simulation are key technologies required both for research and development and for functional verification under in-service conditions.

Gaps in experimental and numerical simulation exist for the simulation of SLD, ice crystal and snow conditions.

A key icing facility offering the opportunity to simulate all relevant icing conditions, including SLD and ice crystals, would substantially expand the relevant infrastructure landscape in Europe and advance the experimental simulation capabilities for the aviation industry. Such a key facility would open up a wide range of uses, for example in research and teaching. Since anti-icing and de-icing technologies are subject to continuous development, the facility would also be helpful in verifying innovative concepts.

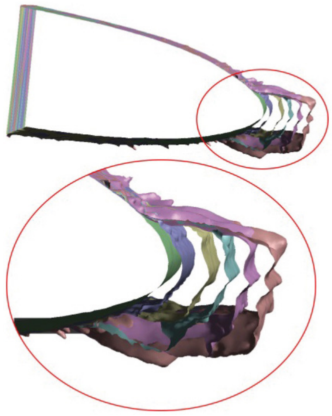

Figure 4: Time-resolved 4D scan of an experimental icing process; source: FH JOANNEUM

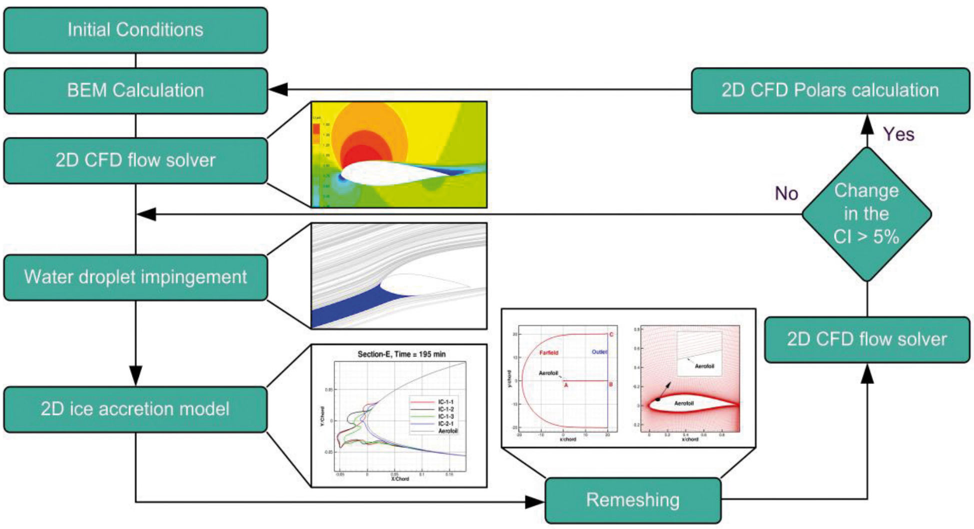

Figure 5: Simulation workflow for assessing rotor performance under icing conditions; source: AIT

2.7. Ice sensing

A strong demand exists for sensors that can detect specific icing conditions such as SLD and ice crystals. Sensors of this kind are designed to ensure an aircraft is operated in the admissible range and thus contribute to flight safety.

As mentioned in section 2.6, SLD and ice crystal conditions are also gaining importance in approval and certification considerations. However, there are currently no sensors available that are able to reliably detect such atmospheric conditions and can be integrated into the aircraft.

2.8. Heating systems and functional coatings

There is a broad potential for the use of heating systems and functional coatings, both in thermal control or comfort applications and in de-icing.

Active and passive functional coatings represent an innovation in ice protection technology. They can be integrated invisibly and provide better aerodynamic efficiency than conventional technologies.

Successful examples of integrated systems include electrically heated coatings, which provide better aerodynamic performance than conventional heating pads while also offering good ice and erosion protection.

2.9. Conclusions

In summary, it can be said that overall IPS efficiency is increasing as a result of lower energy consumption through smart power electronics and sensors on the one hand and the use of alternative passive de-icing technologies on the other. These technologies are designed to provide targeted ice protection in order to retain the required aerodynamic properties. This is all the more important since light helicopters, smaller UAVs and small aircraft usually have only limited energy supply and payload capacity. Optimising energy use in line with the environmental conditions can lead to significant savings in the operating costs of large aircraft and would also allow smaller aircraft to operate in icing conditions.

As mentioned earlier, there is a clear lack of key icing facilities in Europe. The establishment and expansion of test infrastructure for the simulation of relevant icing conditions would provide a decisive competitive advantage in research, innovation and technology at the European and global level.

3. Three objectives – one common vision 2030+

Targeted investment in research and development and effective implementation and exploitation of research results are key drivers of real innovation. The present strategy and its short, medium and long-term objectives are designed to provide a framework for the successful development of innovative products in the field of icing and ice protection. University and non-university research institutions, research infrastructure operators and aircraft and component manufacturers must all be involved in this effort to be able to tap the full potential of these innovations, to develop them into marketable solutions and to integrate them into aircraft as systems suppliers.

The Federal Ministry for Transport, Innovation and Technology (BMVIT) and stakeholders from the Austrian icing community have formulated a common vision for this strategy:

In 2030+, aircraft manufacturers will source innovative products and services for icing and ice protection completely from Austria.

The BMVIT and stakeholders from the Austrian icing community have set three ambitious goals to achieve this vision:

1

Short-term:

Pooling of national R&D expertise in order to enhance international visibility and ensure the generation and consolidation of specialist knowledge

Effective cooperation between university and non-university research institutions, research infrastructure operators and aircraft and component manufacturers is designed to tap the full potential of all stakeholders and to expand relevant expertise. The aim is to minimise redundancies in research and development and to avoid competitive situations. Partnerships within the European Union are encouraged to enhance international visibility.

2

Medium-term:

Establishment of a key icing facility in order to fill European gaps in testing infrastructure

The establishment of high-performance research infrastructure, which also includes an appropriate service portfolio, represents a key pillar of the icing strategy and is designed to fill the gaps in the key research infrastructure landscape. This includes research facilities for experimental simulation together with associated measurement equipment as well as flying test beds and validation setups required for experiments and the validation of system concepts and software tools under realistic conditions.

3

Long-term:

Austria offers icing solutions from research to testing to marketable systems

Application-oriented research projects are to provide practical technical solutions to be translated into marketable products and services in line with market requirements. Austria will be able to offer comprehensive system solutions. Basic research provides the basis for future innovations. The integration of research and teaching ensures continuous education of the next generation of scientists and provides a significant contribution to the value chain of the Austrian aviation industry.

4. Catalogue of measures

The following measures have been defined in coordination with the Austrian icing community in order to implement the short, medium and long-term goals, to strengthen the Austrian icing community and to achieve system capability in the strategic niche of icing and ice protection:

Measure	Description	Time horizon
Establishment of a separate topic within Take Off	Development and demonstration of innovative technologies and functional principles aimed at securing patents and creating demonstrators involving research and teaching. Utilisation of synergies with other technologies, e.g. wind turbine rotors.	Short-term
Call for proposal and implementation of a flagship project within Take Off	National collaborations with research institutions, the aviation (supply) industry and aircraft manufacturers or development firms in the form of research consortia.	Short-term
Participation in calls of the European Framework Programme for Research	Active participation of the national community in cooperative research projects with European partners in order to drive strategic integration into the European R&D environment.	Short, medium and long-term
Active participation in strategically relevant bodies and strengthening cooperation with the European Aviation Safety Agency (EASA)	Representation of Austrian interests in international bodies, e.g. technology platforms at EU level, standardisation bodies. Obtaining Design Organisation Approvals (DOAs) from the certification authority EASA to demonstrate the relevant expertise.	Short, medium and long-term
Establishment of a technical conference in Austria	Linking national with European and international aviation actors in order to establish partnerships, enhance international visibility and provide technologies with a high maturity level for system integration.	Short-term
Establishment of a national icing platform	Linking national with European and international aviation actors in order to establish partnerships, enhance international visibility and provide technologies with a high maturity level for system integration.	Short-term
Expanding the national portfolio of expertise in simulation	Filling of gaps in the fields of experimental and numerical simulation, e.g. simulation of snow, SLD and ice crystals in a key facility or using simulation tools. Use of innovative technologies such as 3D or 4D scanning of ice structures for generating digital databases for the validation and application of simulation tools.	Medium-term

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